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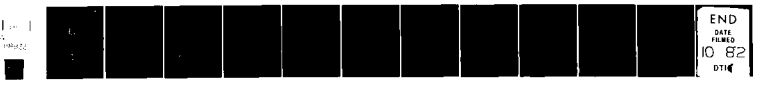

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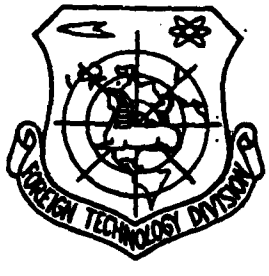
FOREIGN TECHNOLOGY DIVISION

TARGET INDICATION USING A LASER RANGE-FINDER, WORKING OUT THE DATA ON AN HP-25 POCKET CALCULATOR

by

P. Navarin



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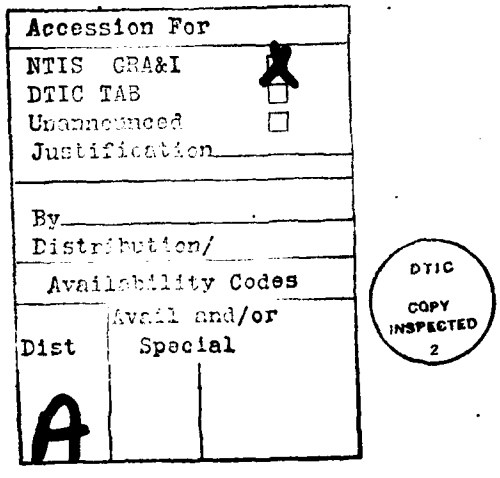

TARGET INDICATION USING A LASER RANGE-FINDER, WORKING OUT THE DATA ON AN HP-25 POCKET CALCULATOR

P. Navarin
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Previous research has confirmed that the use of a laser range-finder (LRF) in conjunction with an HP-25 pocket electronic calculator for artillery observations (optical stations) makes possible rapid and accurate determination of the data necessary for achieving precise and effective fire by artillery units. This refers particularly to those conditions in which there is little time to prepare for artillery action and when, in the course of battle, the artillery is executing fire tasks under complex combat conditions (combat in chance encounters, in previously occupied territories, combat against paratroopers, etc.).

In addition to the determination of initial elements for fire aim and correction, the laser range-finder and HP-25 calculator can be successfully used for the indication of targets ordered for the artillery division by the commanders of the artillery batteries and artillery inspection group (AIG) for their observations and vice versa. For drill in artillery firing, these two devices sight as a team (with the LRF oriented at a right angle at due north), accurately and rapidly indicating the targets by means of other observa-

vers (optical stations), for which rectangular coordinates are known, and who can visually sight these targets.

Due to the direct automatic processing of data by the HP-25, a general program has been worked out which can be used for:

- determining the rectangular coordinates of the observers and targets, on the basis of measured polar coordinates by the laser range-finder;

- rapid and precise indication of targets by other observers (optical stations), using the polar coordinates calculated (when the observers are equipped with laser range-finders).

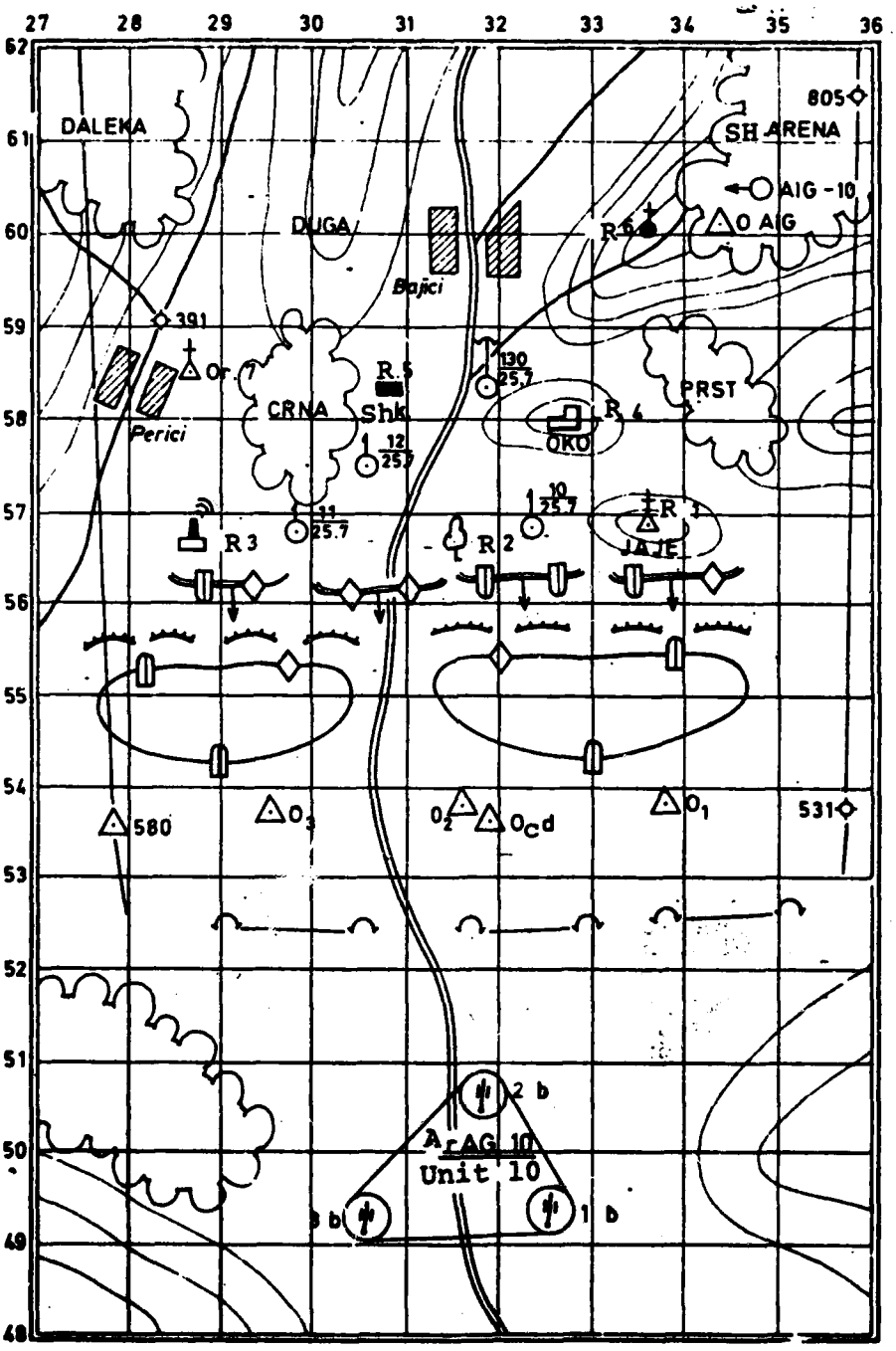
The actions in the case of these target indications may be seen in the following example.

Example 1. Unit 10 was drawn up for battle as shown in Fig. 1. The topographic-geodetic preparation of the division was executed on a full base.

The coordinates of unit 10's observer are presented in Summary 1.

Summary 1

	Coordinates		
	X	Y	Z
Observer Com	53 509.74	31 836.18	571
Observer 1b	53 903.83	33 790.99	526
Observer 2b	53 707.93	31 691.90	552
Observer 3b	53 523.17	29 485.56	553
Observer AIG	60 007.24	34 300.37	647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10
25,7
R 1
JAJE
R 3
R 2
580
O3
O2
Ocd
O1
531
2 b
ArAG 10
Unit 10
3 b
1 b

Fig. 1.

The forward battery and division units are equipped with laser range-finders for the observers.

In the course of division action, the observers for unit 10's commander discovered targets 10, 11, and 12 (see Fig. 1), whose reconnaissance data are written down in the proposed Observation Journal (Table 1). The commander of unit 10 ordered the polar coordinates to be calculated for target indication: observer 1b - target 10; observer 2b - target 12; and observer 3b - target 11.

Table 1. Observation Journal

Observers: Unit 10

X = 53,509.74 Y = 31,863.18 Z = 571

No.	Discovered (brief desc.)	Time of discovery	Target site (data for targ. indic.) Azim. X	Dist. Y	S Z	Front Depth AzF	To whom data was sent	Notes
1	Recoill. plat. at forward edge of broad circ.	25 Jul 16.28	1-24 56 775.39 (59-00)	3290 32 262.71 (3257)	-0-11 535 (+0-03)	100 100	ComBat T10 command neut. at 16.30; 1b comm. at 16.35	1b
2	Mot. arm. plat. for OT in act. in rotary circ.	25 Jul 16.42	57-83 56 632.55 (0-77)	3800 29 700.34 (3118)	-0-27 470 (-0-27)	100 100	ComBat T-11 command neut. at 16.43; 3b comm. at 16.45	3b
3	OT detach. gathered at J/1 edge of Crna forest	25 Jul 17.10	60-80 57 442.92 (60-85)	4185 30 499.27 (3921)	-0-32 440 (-0-29)	200 100 14-00	ComBat T-12 command neut. at 17.11; 2b comm. at 17.13	2b

Notes: In the columns for Azimuth and Distance, the polar coordinates are given in parentheses for targets according to the observer who indicated the target.

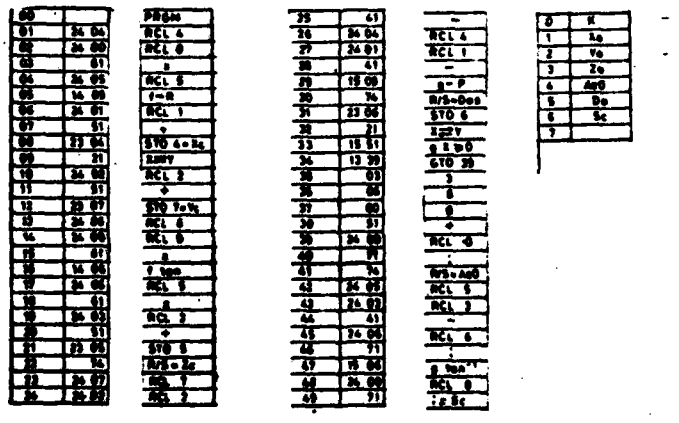
Programmed data processing for target indication is done according to the program (Table 2), with the following results.

a) The Case of T-10 Coordinate Calculation

1. After writing the program in the calculator's program memory and distinguishing the data in part of the REGISTER program, by pressing the GTO 00 key, it is necessary to set the calculator for the first step of calculation.

2. By pressing the R/S key, programmed calculation is begun for data, which ceases at program step 22, at which Zc is read out (535.47 m).

Table 2. Program for HP-25 calculator, for determining coordinates and target indication, using a laser range-finder.



Program Step no.	Code	Key	Program Step no.	Code	Key	Register No.	Register Content
00		PRGM	35	41	-	0	K
01	34 04	RCL 4	36	34 04	RCL 4	1	x_0
02	34 00	RCL 0	37	34 01	RCL 1	2	y_0
03	41	-	38	41	-	3	z_0
04	34 05	RCL 5	39	15 00	g - P	4	A_{DS}
05	14 00	1/x	40	14	R/S	5	D_{OS}
06	34 01	RCL 1	41	22 04	STO 4	6	β_c
07	51	*	42	21	x≷y	7	
08	22 04	STO 4	43	15 51	g RAD		
09	21	x≷y	44	13 39	GTO 39		
10	34 00	RCL 0	45	03	3		
11	51	*	46	05	5		
12	22 07	STO 7	47	00	0		
13	34 00	RCL 0	48	51	*		
14	34 00	RCL 0	49	34 00	RCL 0		
15	51	*	50	71	*		
16	14 00	1/x	51	34 05	RCL 5		
17	34 05	RCL 5	52	24 03	SIN		
18	51	*	53	34 03	RCL 3		
19	34 03	RCL 3	54	71	*		
20	51	*	55	34 04	RCL 4		
21	22 05	STO 5	56	71	*		
22	14	R/S	57	15 00	g Dos		
23	34 07	RCL 7	58	34 00	RCL 0		
24	34 00	RCL 0	59	71	*		

Notes: In calculating rectangular coordinates for a target, the observation distance measured (Dos) is reduced to the horizon before recordon the calculator. Here, if and Do up to 2000 m and and Do over 2000 m.

By pressing key RCL 4, the calculated height Xc is indicated on the read-out (56,775.39), and the calculated height Yc is indicated by pressing key RCL 7 (32,262.71).

Notes. When the program is used to calculate rectangular coordinates of special observers on the basis of a known point, before recording the data in the preparatory register of the calculator, the azimuth measured at the known point must be changed to 32-00 and the presign of the local angle.

b) The Case of Calculating Polar Coordinates for a Target for the Observer (Optical Station) who Indicated the Target

After calculating the target coordinates (see under a)), the procedure is as follows.

1. The rectangular coordinates of the observer (X, Y, Z), which indicate the target (0_1), are recorded in memories STO 1, STO 2, and STO 3 in individual registers.

2. By pressing key GTO 23, the calculator is set at program step 23.

3. Key R/S is pressed three times and we can read off the polar coordinates of T-10 for the observer who indicated the target (battery 1):

- first time: observation distance (Dos = 3257 m);

- second time: observation azimuth (AzO = 59-00);

- third time: local angle with its presign (S = + 0-03).

On the basis of the known rectangular coordinates Ocd and 01 (see Summary 1) and the measured polar coordinates, the unit 10 commander orders the polar coordinates to be calculated for target 10 at 0_1, indicates the target, and transmits the data to the commander of battery 1 (see Table 1 and Fig. 1): "DRAVA-1, T-10, observer, observation azimuth 59-00, distance 3.257, local angle + 0-03, recoilless weapons platoon in action, at the forward edge of a broad circuit, neutralize!".

Upon the battery 1 observers receiving the polar coordinates ordered for the LRF and finding the indicated target at the cross hairs (or its immediate vicinity) based on the data given, the LRF executes control of its sighting by measuring the distance to the target, and then they execute: "DRINA, target 10 sighted, neutralize!".

The solutions for targets 11 and 12 are given in the Observation Journal (Table 1) for the unit 10 observers.

Use of the proposed procedure for indicating encircled enemies of the AIG reconnaissance battery, which were discovered by sonar or radar sighting or using aerial photos, is very convenient, because of its test and additional reconnaissance data, which is also confirmed in the solution to example 2.

Example 2. After uttering the hypothetical commands, the unit 10 commander left AIG-10 in the Sharena region, which had the data for observing and determining the target coordinates by using the laser range-finder.

In the course of the action, the unit 10 commander ob-

tained the following data.

"DRINA, according to sonar, T-130, X = 58,310, Y = 31,807, Z = 335, approaching, 105 mm batteries, verify and report!".

The division reconnaissance unit, calculat che polar coordinates with AIG-10 observers for target 13 ccording to the program (Table 2) (see Fig. 2) [Translat s Note: Fig. 2 was not included in the original article e translated].

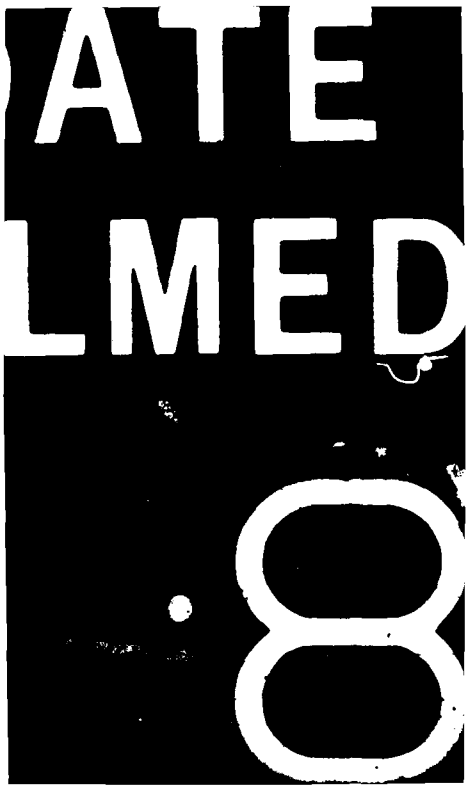
In this case, the program is used as follows:

1) the rectangular coordinates of target 130 are recorded in the calculator register: Xc = STO 4, Yc = STO 7, and Zc = STO 5;

2) the next step is the same as in the case in which a target is indicated whose rectangular coordinates were first calculated according to the program in Table 2;

3) the unit 10 commander orders the AIG: "ZETA, T-130, observer, observation azimuth 41-93, distance 3,023, local angle - 1-05, 105 mm battery, verify and report!";

4) after executing the task, AIG-10 reports: "DRINA, T-130, X = 58,322, Y = 31,831, Z = 339, accurate, vehicular 105 mm howitzer battery, 6 weapons, AzF = 17-00, front 200, depth 100!".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